# PROCEEDINGS

OF THE

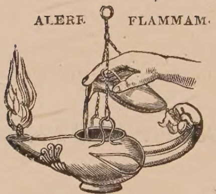
# PHYSICAL SOCIETY OF LONDON

*From October* 1892 *to January* 1894.

VOL. XII.

Physikalische Gesellschaft zu Berlin

LONDON:
PRINTED BY TAYLOR AND FRANCIS,
RED LION COURT, FLEET STREET.
MDCCCXCIV.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RED LION COURT, FLEET STREET.

Kaiser Wilhelm-Institut für medizinische Forschung
Bibliothek
163
* Heidelberg *

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II. Illustrative of Prof. J. Perry's Paper on Liquid Friction.

III. Illustrative of Mr. C. V. Boys's Paper on the Drawing of Curves by their Curvature.

# PROCEEDINGS

AT THE

# MEETINGS OF THE PHYSICAL SOCIETY

OF LONDON.

## SESSION 1893-94.

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### February 10th, 1893.

**Walter Baily**, M.A., Vice-President, in the Chair.

Mr. C. E. **Grove** was elected a Member of the Society.

Dr. J. H. **Gladstone**, F.R.S., read a paper on "Some Recent Determinations of Molecular Refraction and Dispersion."

Mr. E. C. C. **Baly** read a paper on "Separation and Striation of Rarefied Gases under the Influence of the Electric Discharge."

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### February 24th, 1893.

Prof. A. W. **Rücker**, President, in the Chair.

Prof. J. D. **Everett**, F.R.S., communicated a paper on "A new and handy Focometer."

A paper by G. H. **Bryan**, M.A., on "A Hydrodynamical Proof of the Equations of Motion of a Perforated Solid, with Applications to the Motion of a Fine Rigid Framework in Circulating Liquid," was read by Dr. C. V. **Burton**.

Appended to the paper is a note by Dr. **Burton** relating to the proper measurement of the impulse of cyclic motion; and in a further note Mr. Bryan shows how the equations of motion may be deduced from Dr. Burton's suggestions.

Dr. C. V. Burton read a paper on "Plane and Spherical Sound-Waves of Finite Amplitude."

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March 10th, 1893.

Prof. A. W. Rücker, President, in the Chair.

Mr. W. Williams was elected a Member of the Society.

Dr. C. V. Burton read a paper "On the Applicability of Lagrange's Equations of Motion in a general class of Problems, with especial reference to the Motion of a Perforated Solid in a Liquid."

Prof. G. M. Minchin read a paper "On the Magnetic Field of a Circular Current."

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March 24th, 1893.

Prof. A. W. Rücker, President, in the Chair.

Some excellent photographs of flying bullets and of the air-waves produced by vibrating hammers were exhibited, the originals of which had been taken by Prof. Mach.

The following communications were made:—

"On the Differential Equation of Electrical Flow." By Thomas H. Blakesley, M.A.

"On the Viscosity of Liquids." By Prof. J. Perry, F.R.S., assisted by J. Graham, B.A., and Mr. C. W. Heath.

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April 28th, 1893.

Prof. W. E. Ayrton, Past President, in the Chair.

Mr. F. Harrison was elected a Member of the Society.

A discussion took place upon the subject of the paper by Prof. Perry, read March 24th, on the Viscosity of Liquids.

Prof. Perry read a communication he had received from Prof. Maurice Fitzgerald on the subject, in which the latter discussed the corrections necessary for reducing the results obtained by circular motion to the corresponding motion in plane layers. He shows that, in addition to the circular motion, the effect is complicated by radial flow, due to "centrifugal head," which causes the liquid to pass outwards near the bottom of the trough, and inwards across the edge of the suspended cylinder, with continuations along the sides of the trough and cylinder. Taking this motion into account, the formula

$$v = Ar^{1+\frac{c}{\mu}} + \frac{B}{r}$$

is deduced, where $v$ is the velocity, $\mu$ the viscosity, A and B arbitrary constants, and $c$ a constant depending on the radial flow. When $c=0$ the formula reduces to equation (5) of the paper, whilst if $c=-2\mu$ it becomes

$$v = \frac{C}{r}.$$

The subject of critical velocities in non-turbulent motion is referred to, and some probable effects of the anomalous variations of density and viscosity of sperm-oil, noticed by the authors of the paper, are pointed out.

Prof. Perry, in further reply to Prof. Osborne Reynolds's comments, said he understood Prof. Reynolds to have proved that friction was proportional to velocity when the motion was steady. Experiments he (Prof. Perry) had made with disks of iron and glass in revolving mercury seemed to show that this was not the case. On replacing the mercury by sperm-oil he found that up to a certain speed friction was strictly proportional to velocity, whilst above that speed friction varied as $v^{1\cdot25}$. Coloured streaks in the liquid remained unbroken even at the highest speeds. He therefore concluded that continuity of the streaks was not necessarily accompanied by a linear law of friction.

Mr. E. C. Rimington read a paper on "Luminous Discharges in Electrodeless Vacuum-Tubes."

May 12th, 1893.

Prof. A. W. Rücker, President, in the Chair.

The following communications were made:—

"On the Drawing of Curves by their Curvature." By C. V. Boys, A.R.S.M., F.R.S.

"On the Foundations of Dynamics." By Prof. O. J. Lodge, F.R.S.

### May 26th, 1893.

Prof. A. W. Rücker, President, in the Chair.

Mr. C. J. Woodward showed some "Experiments with a Vibrating Bar."

On suspending the bar by two loops of cord, and placing it over a resonance box, the sound was greatly intensified. When placed crosswise, and partly over the box, a position could be found where no increase of sound resulted, whilst a little movement in either direction from this position caused a considerable increase.

The discussion on Dr. Lodge's paper, "The Foundations of Dynamics," was then resumed.

Communications on the subject from Mr. S. H. Burbury, Dr. G. Johnstone Stoney, and Prof. E. F. Herroun were read.

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### June 9th, 1893.

Prof. J. Perry, F.R.S., Vice-President, in the Chair.

Prof. A. Jamieson, Prof. H. Stroud, and Mr. J. Wade were elected Members of the Society.

The following communications were made:—

"A new Photometer." By Mr. A. P. Trotter.

"Some Notes on Photometry." By Prof. S. P. Thompson, F.R.S.

"The Magnetic Field close to the Surface of a Wire conveying an Electric Current." By Prof. G. M. Minchin, M.A.

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### June 23rd, 1893.

Prof. A. W. Rücker, President, in the Chair.

Prof. J. Cox, M.A., was elected a Member of the Society.

Mr. F. H. Nalder exhibited a Bridge and Commutator for comparing Resistances by Prof. Carey Foster's Method.

Mr. R. W. Paul exhibited a compact form of Sulphuric-acid Voltameter of small resistance. The voltameter is a modification of a pattern designed at the Central Institution, in which the rate of decomposition is determined from the time required to fill a bulb made in the stem of a thistle-funnel. He also showed a handy form of Daniell cell, devised by Prof. Barrett. When not in use, the porous pot containing the zinc is removed from the copper sulphate solution, and placed in a vessel containing zinc sulphate or sulphuric acid.

Mr. W. R. Pidgeon and Mr. James Wimshurst each read a paper on "An Influence Machine," and exhibited their machines in action.

A paper on "A new Volumenometer," by Mr. J. E. Myers, describing the developed form of Prof. Stroud's instrument, was, in the absence of the Author, taken as read.

A paper on "Long-distance Telephony," by Prof. J. Perry, F.R.S., assisted by H. A. Beeston, was read by the former.

October 27th, 1893.

Prof. J. Perry, F.R.S., Vice-President, in the Chair.

Mr. E. C. Rimington read a paper "On the Behaviour of an Air-Core Transformer when the Frequency is below a certain Critical Value."

November 10th, 1893.

Prof. A. W. Rücker, President, in the Chair.

Mr. R. S. Cole was elected a Member of the Society.

The following communications were made:—

"The Separation of Three Liquids by Fractional Distillation." By Prof. F. R. Barrell, Mr. G. L. Thomas, and Prof. S. Young.

"Note on the Generalizations of Van der Waals regarding Corresponding Temperatures, Pressures, and Volumes." By Prof. S. Young.

An Instrument for drawing Conic Sections was exhibited and described by Mr. J. Gillett, B.A.

This consists of a spindle inclined to a plane board, and a tube fixed to the spindle at an angle. A pencil which passes through the tube traces out a cone in space as the spindle is turned, and on sliding the pencil through the tube so as to keep its point against the plane, the point traces out a conic—the section of the cone made by the plane of the board. A circle, ellipse, parabole, or hyperbole can be drawn according to the inclination of the spindle to the board.

Prof. HENRICI said a similar instrument had been described in an Arabian manuscript 1000 years old, and had been independently re-invented by both a German and an Italian mathematician. He thought the fact of the angle between the spindle and the tube in Mr. Gillett's instrument not being adjustable was a disadvantage.

Mr. INWARDS and Prof. HERSCHEL also took part in the discussion, to which Mr. GILLETT replied.

### November 24th, 1893.

Prof. A. W. RÜCKER, President, in the Chair.

Col. MAITLAND, C.B., was elected a Member of the Society.

Prof. S. P. THOMPSON occupied the Chair while the President read a paper "On the Magnetic Shielding of Concentric Spherical Shells."

Prof. G. M. MINCHIN, M.A., read a paper "On the Action of Electromagnetic Radiations on Films containing Metallic Powders."

### December 8th, 1893.

Prof. A. W. RÜCKER, President, in the Chair.

Mr. J. A. GILLETT and Mr. F. HOVENDEN were elected Members of the Society.

A paper by Mr. JAMES SWINBURNE, "On a Potentiometer for Alternating Currents," was read by the Hon. Secretary.

Prof. G. M. MINCHIN, M.A., made communications "On the Calculation of the Coefficient of Self-Induction of a Circular Current of given Aperture and Cross-Section," and "On the Magnetic Field of a Current running in a Cylindrical Coil."

### January 26th, 1894.

Prof. A. W. RÜCKER, President, in the Chair.

The following communications were made:—

"On a new Mode of making Magic Mirrors." By Mr. J. W. KEARTON.

"Some Observations on Diffraction." By Mr. W. B. CROFT.

"A new Photometric Method, and Photometer for same." By Mr. J. W. SPURGE.

## *Annual General Meeting.*

February 9th, 1894.

Prof. A. W. Rücker, President, in the Chair.

The following Report of the Council was read by the Chairman :—

The Council has this year to congratulate the Society upon the completion of twenty years of useful existence. The foundation took place in 1874; and it is a satisfaction to know that a very large proportion of the founders is still alive and as enthusiastic for the welfare of the Society as a score of years ago.

During this time the Society has published nearly twelve volumes of 'Proceedings,' besides translations from foreign sources of the important Physical Memoirs of Helmholtz, Hittorf, Puluj, and Van der Waals, as well as the entire Scientific Works of Joule and of Wheatstone.

The Council has never made the mistake of refusing any communication which has turned out eventually to have embodied matters of genuine interest in Physics, and every new idea of importance in this field has always found a welcome reception and an early public utterance in England at the meetings of this Society.

Of late the Council of the Physical Society has been the first body to give expression to the desire generally felt by the followers of Physical Science that some single central and widely inclusive publication of Physical work should be set on foot and issued periodically in the English language. It is felt that such a work would be of the utmost value to scientific men; and though the idea is perhaps still in the nebulous condition, it may be of interest to the Members generally to know that the Council has taken the initiative in making its opinions upon this subject known in quarters where it is hoped some cooperation may be afforded.

The Society has to regret the loss by death of Professor John Tyndall and of Mr. Paice.

The world as well as this country, where he was lately a visitor, must have heard with the keenest sorrow of the death of Professor Hertz.

Since the last Annual General Meeting there have been fourteen Ordinary Meetings.

The following additions have been made to the Library during 1893–94:—

*Newspapers and Magazines*:—

Nature.
Electrical Review.
Electrician.
Electrical Plant.
Ingeniero y Ferretero Español y Sud Americano.
Crónica Cientifica.
Invention.
The Open Court.
The Iron, Steel, and Coal Times.
Engineering.
Industries and Iron.
The Philosophical Magazine.
Beiblätter der Physik.
Annalen der Physik.
Journal de Physique.

*Journals of Societies, British*:—

Journal of the Society of Arts.
Proceedings of the Birmingham Philosophical Society.
Transactions and Proceedings of the Cambridge Philosophical Society.
Transactions and Proceedings of the Royal Dublin Society.
Journal of the Institute of Electrical Engineers.
Memoirs and Proceedings of the Manchester Literary and Philosophical Society.
Proceedings of the Institute of Mechanical Engineers.
Quarterly Journal of the Royal Meteorological Society.
Proceedings of the Royal Institution.
Proceedings of the Royal Society.
Proceedings of the Edinburgh Mathematical Society.
Journal of the Camera Club.

*Journals of Societies, Colonial*:—

Journal and Proceedings of the Royal Society of New South Wales.
Geological and Natural History Survey of Canada: Annual Report and Maps.

Hong Kong Observatory Observations.
Proceedings and Transactions of the Nova Scotia Institute of Natural Science.
Transactions of the Canadian Institute, and 5th Annual Report.
Papers of the Mathematical and Physical Society of Toronto.

*Journals of Societies, Foreign*:—

Journal of the Physical and Chemical Society of Russia.
Verhandlungen, Berlin Physical Society.
Mémoires and Séances of the Physical Society of France.
Journal of the College of Science, Japan.
Transactions of the Seismological Society, Japan.
Seances and Bulletin International de l'Académie des Sciences, Cracovie.
Prace Matematyczno-Fizyczna, Warsaw.
Report of the Ohio Meteorological Bureau.
Technology Quarterly and Proceedings of the Society of Arts, Massachusetts.
Report of the Ohio Weather and Crop Service.
Proceedings of the Academy of Natural Sciences, Philadelphia.

*Books, &c.*:—

Waterdale Researches, by Waterdale.
Inertia of Matter, by Ernest Major.
Œuvres de Laplace, Tome ix.
Smithsonian Report, 1890.
Greenwich Magnetic and Meteorological Observations, 1890.
Greenwich Spectroscopic and Photographic Results, 1890.
Personal Recollections of Werner von Siemens.
University College Calendar.
University of Japan Calendar.
Catalogue of the Stratigraphical Collection of Canadian Rocks of the Chicago Exhibition.
Electricity in the Service of Man; translated from the German by Dr. Wormell.

In the death of Professor TYNDALL, which took place on Dec. 7, 1893, the Society has suffered the loss of one of its most distinguished Members, and English Science one of its most prominent representatives. Though he very rarely attended our Meetings, he warmly approved of the objects for which our Society was founded; he joined almost at the outset, and became a Life Member.

John Tyndall was born near Carlow, in Ireland, of parents in a humble rank of life, his father having been in the old Inland Revenue Police, with which he combined a small business as leather-dealer. There are grounds for believing that he is of the same stock as William Tindale, the first English translator of the Bible, and that his ancestors, with other cloth-workers, migrated from Gloucestershire to Ireland in the 17th century.

Tyndall's father was a strong Protestant, and Tyndall's early days, spent in the midst of Roman Catholic surroundings, accustomed him to religious controversy, and had much to do with the ability he afterwards developed in defending any position which he took up.

Up to the age of nineteen years he attended a local school, the master of which was Mr. Cornill, a Roman Catholic, for whom Tyndall always entertained respect and regard. On leaving school he obtained an appointment as Civil Assistant in the Ordnance Survey at a very small salary, which, however, with his abstemious habits, was sufficient for his modest needs.

The experience and knowledge Tyndall had gained in the Ordnance Survey was of great service, and on leaving he had no difficulty in getting employment as a Civil Engineer; he was engaged by a Manchester firm of Engineers, and was occupied in surveying and laying-out lines of railway in Lancashire and Yorkshire in that period of busy activity which culminated in the Railway Mania of 1846. Much of his time was spent in the neighbourhood of Preston, and, working hard as he did at his professional work, he yet found time for private study and other forms of mental improvement.

There he formed the acquaintance of Mr. George Edmondson, a member of the Society of Friends, who had a large and successful school at Tulketh Hall, near Preston, conducted on modern principles. On the failure of the Community formed by Robert Owen in Hampshire, the buildings were found to be admirably adapted for a school. Mr. Edmondson was induced to transfer his school thither. This was done in 1846, and the establishment was opened, under the name of Queenwood College, as a School and an Agriculture and Technical College, for which a large quantity of land formerly belonging to the Community was available.

Tyndall was in 1847 appointed as Teacher of Mathematics and Surveying, and Dr. Frankland of Chemistry and Physics, in the new undertaking. The difference in the ages of the Agricultural pupils and of the School boys made it difficult to work the two together, and it was ultimately decided to abandon the Agricultural Department. The School then began to improve. Mr. Edmondson, like many of the religious body to which he belonged, had great zeal and enthusiasm for education, quite fully alive to modern ideas, and with great capacity for organization. The School realized more than forty years ago what many are now wishing for, namely, a place in which Mathematics, the Sciences, and Modern Languages occupied the dominant position, Classics a subordinate one. The aims of the School were advanced; not less remarkable were some of the teaching staff engaged to carry them out in the department of Mathematics and the Sciences: it will be sufficient to mention only the names of Tyndall and of Hirst, whose loss this Society had last year to deplore, of Frankland and Debus. Which among our richly endowed public schools can show such a record as this? As was remarked by one who well knew Queenwood, "Only when we have seen other places do we fully realize how good a school Queenwood was."

During his stay at Queenwood Tyndall worked at Chemistry under his colleague Frankland, who in turn had the advantage of Tyndall's teaching in Mathematics.

After about a year at Queenwood, Tyndall went with his colleague Frankland to the University of Marburg, attracted by the fame of our distinguished and venerable honorary Member, Bunsen. There he worked at Chemistry, Mathematics, and Physics, but gave himself more to the latter subjects; and on taking his degree as Doctor of Philosophy, the subject of the Dissertation, which it was necessary to present for that purpose, was purely mathematical—"On a screw surface with inclined generatrix."

After a short visit to England in 1850 he returned to Marburg, accompanied by his friend Hirst. Previous to his return he called upon Dr. Francis, then, as now, Editor of the 'Philosophical Magazine,' and the result of this was that he entered into an engagement to furnish for that journal a series of reports on the Progress of the Physical Sciences in Germany; the first of these appeared in March 1851, and gave an account of recent researches on Electromagnetism.

Tyndall's first original work was one carried out in conjunction with Prof. Knoblauch, of Marburg, Extraordinary Professor of Physics there; it appeared in the 'Philosophical Magazine' for March 1850, under the title "On the Deportment of Crystalline Bodies between the Poles of a Magnet."

In this year he carried on by himself a research on the laws of magnetism in the laboratory of his friend Knoblauch, and published a paper on the subject in the 'Philosophical Magazine.' He went later to Berlin, where he worked in 1851 in the laboratory of Magnus, and here he made the acquaintance of the leading German Physicists, such as Du Bois-Reymond, Poggendorff, and Clausius.

In 1851 he returned to England, resuming his appointment at Queenwood, and in 1851 published a paper on the Polarity of Bismuth, the experiments for which were made in the laboratory of Magnus. He continued his researches at Queenwood, contributing at the same time his reports and also translations to the 'Philosophical Magazine.' These reports were eagerly welcomed by the English Physicists of that day, notably by Faraday and Grove. The interest which they aroused, and the high opinion held of him by the Physicists of Berlin (which Dr. Bence Jones, the Secretary of the Royal Institution, learnt of on a visit to Berlin), led to his being invited to give a Friday evening Lecture at the Royal Institution. The subject of this Lecture was on the "Influence of Material Aggregation on the Manipulation of Force." As our first President, Dr. Gladstone, observes—"The lecture was characterized by great *élan*, and a fine display of experimental powers, and seemed to take the audience by storm." Dr. Frankland says—"This lecture, though upon such an abstruse subject, took his audience, most popular as it was, by storm, and he received at the close quite an ovation."

The success of that lecture was such that, on the proposition of Faraday, he was shortly afterwards appointed Professor of Natural Philosophy in the Royal Institution. He left Queenwood to enter on his new duties there in July 1853, and was succeeded in his appointment by Dr. Hirst.

From that time his career has been before the world.

Tyndall's scientific work ranged over a wide extent of physical science. His thesis for his doctorate at Marburg was an essay on Screw-surfaces, a more mathematical topic than any which he subsequently attempted. His first physical paper was on the phenomena of a water-jet, in which he showed that the noises of streams and waterfalls are due to the entanglement of air. Before he left Marburg, the work which he had undertaken in conjunction with Knoblauch, on the magneto-optic properties of crystals and the relation of magnetism to molecular arrangement, was ready for publication. His second research on Diamagnetism was made in Berlin, where he worked under Magnus. In 1853, when he returned to London, he lectured on these researches at the Royal Institution, and in May of that year was chosen Professor of Natural Philosophy. For the next year or two he continued to work at Magnetism, and investigated the effect of pressure and of cleavage upon the magnetic and diamagnetic properties of matter. In the course of this work he was led to study glacier problems. After the publication, in 1855, of his essay on Slaty Cleavage he visited Switzerland in company with Professor Huxley, to investigate glacial action: and in 1860 he published his work on the Glaciers of the Alps. His mountaineering exploits in subsequent years are known to all the world. While at Marburg he had also worked at the phenomena of Heat, which formed the subject of prolonged researches. In 1852 he had sent to the Royal Society a paper on the conduction of heat through organic substances, such as wood, in which he proved the axis of maximum conductivity to coincide with the axis of maximum cohesion—namely, along the grain. But in 1859 he passed on to the study of the radiation of heat, and of the action of gases and vapours on the same. For some ten years he continued these researches. The Bakerian lecture for 1861 was his first formal memoir on this investigation. Using the thermopile as the measurer of radiation, and tubes closed by plates of rock-salt, he sought to unravel the absorptive powers which different vaporous media exert upon radiations of different sorts. He found the elementary and simple gases to absorb far less than those of more complex structure, the absorption increasing with the complexity of the molecular structure. The radiating powers present a corresponding contrast. Essences were found to produce unexpectedly great absorption. As with his researches on Diamagnetism, so with those on Radiant Heat, he collected the substance of his scattered memoirs into a volume which was published in convenient form for reference. In 1863 his more popular work 'Heat a mode of Motion' dealt mainly with elementary thermodynamics, and did useful service in bringing that subject to the level of comprehension of the ordinary educated reader. A like service was performed by his other popular works on Sound and on Light, the latter being a reproduction of the lectures which he delivered in America in 1872. These lectures were a brilliant experimental exposition of physical optics on a scale never before attempted. Tyndall also published two small volumes of notes on Electricity; but they were little more than synopses of his lectures, and did not aim at originality. From about the year 1875 Tyndall's attention was taken up with the germ theory of putrefaction, which he investigated with characteristic zest, employing as an observing agent a powerful beam of light, to detect the floating germs. It was in the course of these experiments that Tyndall discovered that to produce complete sterilization of the infusions employed it would not suffice to heat to boiling-point once, but that repeated raising to the boiling-point at intervals was infallibly successful. Till about 1883 he was actively occupied with this work; and he resumed the subject at intervals till the final breakdown of his health in 1886. From 1850 to 1883 he published no fewer than 135 memoirs and papers, beside numerous scattered Magazine articles and addresses, many of which were republished in the two volumes entitled 'Fragments of Science.' No account of Tyndall's activities would be complete which did not contain some reference to the numerous controversies into which he entered with various scientific men. He was an uncompromising adversary even in purely scientific topics. His dispute with Prof. J. D. Forbes on the origin of glacial motion, and that with Prof. Tait as to the merits of Robert Julius Mayer as the founder, rather than Joule, of the dynamical theory of heat, witness to this personal trait. His controversy with Prof. W. Thomson (now Lord Kelvin) on the subject of diamagnetic polarity was a curious episode, since the opinion, which seems to have been held at the time, that Tyndall had answered his critic's strictures would not now be upheld by any competent authority. His anti-theological utterances of the seventies, and his political diatribes of the past seven years, though intensely characteristic of the man, are no part of his scientific work. He retired after the breakdown in health of 1886 to the solitude of his residence at Hindhead, where he died on December 4, 1893.

Great as were his abilities as an investigator they were surpassed by his powers as an expounder. His public lectures were models of lucid exposition; and his patience and skill in the performance of difficult experiments unrivalled.

The adoption of the Report was proposed and passed unanimously.

The election of Officers and other Members of Council then took place, the new Council being constituted as follows :—

*President.*—Prof. A. W. Rücker, M.A., F.R.S.

*Vice-Presidents who have filled the Office of President.*—Dr. J. H. Gladstone, F.R.S.; Prof. G. C. Foster, F.R.S.; Prof. W. G. Adams, M.A., F.R.S.; The Lord Kelvin, D.C.L., LL.D., P.R.S.; Prof. R. B. Clifton, M.A., F.R.S.; Prof. A. W. Reinold, M.A., F.R.S.; Prof. W. E. Ayrton, F.R.S.; Prof. G. F. Fitzgerald, M.A., F.R.S.

*Vice-Presidents.*—Walter Baily, M.A.; Major-General E. R. Festing, R.E., F.R.S.; Prof. J. Perry, D.Sc., F.R.S.; Prof. S. P. Thompson, D.Sc., F.R.S.

*Secretaries.*—H. M. Elder, M.A.; T. H. Blakesley, M.A., M.Inst.C.E.

*Treasurer.*—Dr. E. Atkinson.

*Demonstrator and Librarian.*—C. Vernon Boys, F.R.S.

*Other Members of Council.*—Shelford Bidwell, M.A., LL.B., F.R.S.; W. E. Sumpner, D.Sc.; Prof. G. Fuller; J. Swinburne; G. Johnstone Stoney, M.A., F.R.S.; R. E. Baynes, M.A.; Prof. G. M. Minchin, M.A.; L. Fletcher, M.A., F.R.S.; Prof. O. Henrici, Ph.D., F.R.S.; Prof. S. Young, D.Sc., F.R.S.

Votes of thanks were passed to the Lords Committee of the Council on Education; to the Officers; and to the Auditors.

## The Treasurer in Account with the Physical Society, from January 1st, 1893, to December 31st, 1893.

| *Dr.* | £ *s.* *d.* | £ *s.* *d.* |
|---|---|---|
| Balance in Bank, January 1, 1893 | | 266 13 10 |
| Entrance-Fees | 10 0 0 | |
| Life Compositions | 60 0 0 | |
| Subscriptions for 1891 | 6 0 0 | |
| „ 1892 | 21 0 0 | |
| „ 1893 | 123 0 0 | |
| „ 1894 | 4 0 0 | 224 0 0 |
| Dividends, less Income Tax:— | | |
| Furness 4 per cent. Debenture Stock | 15 11 8 | |
| Lancaster Corporation Stock * | 3 17 10 | |
| Midland 4 per cent. Preference Stock | 35 1 3 | |
| New South Wales 3½ per cent. Stock | 8 13 1 | |
| Metropolitan Board of Works Stock | 6 16 4 | 70 0 2 |
| Sale of Proceedings, Books, and Memoirs | | 32 7 9 |
| Balance due to Treasurer | | 2 18 0 |
| | | £595 19 9 |

| *Cr.* | £ *s.* *d.* | £ *s.* *d.* |
|---|---|---|
| Balance due to Treasurer | | 8 7 8 |
| Taylor and Francis:— | | |
| Proceedings, vol. xii. (parts 1 and 2) | 81 12 0 | |
| Members' separate copies | 15 10 6 | |
| Miscellaneous printing | 47 9 9 | |
| Postage | 9 13 9 | 154 6 0 |
| Gyde (Binding) | | 2 0 0 |
| Haggard (Binding) | 6 15 0 | |
| Hoxey (Binding) | 5 2 0 | |
| Williams and Norgate | 2 18 9 | 14 15 9 |
| Attendance and petty expenses | | 8 3 9 |
| Purchase of £100 Midland Preference Stock | | 134 6 9 |
| Bank Charges | | 0 1 0 |
| Petty Cash:— | | |
| Mr. Elder | 2 5 0 | |
| Dr. Atkinson | 1 13 0 | 3 18 0 |
| Reporting | | 30 10 11 |
| Balance in Bank | | 239 9 11 |
| | | £595 19 9 |

* Second half-year's dividend delayed at Bankers; will appear in 1894 accounts.

EDMUND ATKINSON, *Treasurer.*

Audited and found correct,

A. P. TROTTER,  
RICHARD INWARDS, } *Auditors.*

February 5th, 1894.

# PROPERTY ACCOUNT OF THE PHYSICAL SOCIETY, DECEMBER 31, 1893.

| ASSETS. | £ | s. | d. | LIABILITIES. | £ | s. | d. |
|---|---|---|---|---|---|---|---|
| Balance at Bank | 239 | 9 | 11 | Subscriptions received in advance | 4 | 0 | 0 |
| Subscriptions due, estimated | 28 | 0 | 0 | | | | |
| £400 Furness 4 per cent. Debenture Stock | 456 | 0 | 0 | | | | |
| £1000 Midland 5 per cent. Preference Stock | 1194 | 0 | 0 | | | | |
| £200 Metropolitan Board of Works Stock | 217 | 0 | 0 | | | | |
| £200 Lancaster Corporation 4 per cent. Stock | 224 | 0 | 0 | | | | |
| £254$\frac{2}{3}$ New South Wales $3\frac{1}{2}$ per cent. Stock | 249 | 7 | 5 | Balance | 2603 | 17 | 4 |
| | £2607 | 17 | 4 | | £2607 | 17 | 4 |

EDMUND ATKINSON, *Treasurer.*

Audited and found correct,

A. P. TROTTER,
RICHARD INWARDS, } *Auditors.*

February 5th, 1894.